Economic Effects of Climate Change on California's Forestry Sector

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  - Yes, it dominates public policy over forests that cover 25% of California land area
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- What is the state of the timber industry?

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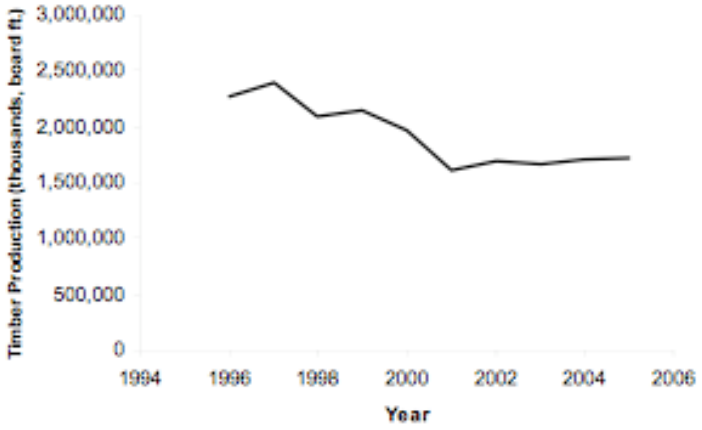
  - Forest products industry is the single largest employer in several counties
- What is the state of the timber industry?
  - California timber production has shrunk dramatically
  - From 1991-2006 timber production fell by 45%
  - Causes: growing emphasis on recreation, threatened species protection, now maybe in the future climate change?

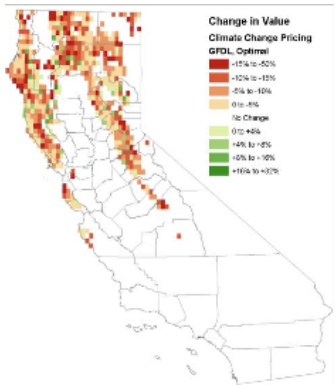


Outline: Forecasting the future given climate change

Climate scenario + Biological parameters

Economic model

Result: % change in land value



Opening the black box*

- What the economic model needs to do: compare land values given climate change and land values given no climate change
- How do we determine land values?
- Revisiting a classic forest economics problem: Finding the optimal rotation period. How long should a tree grow before you cut and replant?
- 150 years ago, Martin Faustmann derived a formula for the present value of income streams over an infinite cycle of forest rotations assuming a static environment
- This is our land value, but remember it is the *percentage change* in the land value that we care about most

From static to dynamic optimization

- Classic problem: “Should I harvest now and get the current value of timber or should I wait, forgoing immediate payoff but knowing I will get a larger payoff in the future?”

- However, climate change introduces dynamics into this by affecting:
  - site suitability of individual tree species
  - tree growth rates
  - global timber prices
- All of these are species specific, and very soon we get a particularly complicated problem

- On each site of land, the forester has to decide when to harvest the timber and what species to replant in its place

An adaptation story

- Foresters are equipped with 2 fundamental adaptive responses to climate change:
  - Intensive margin: adjusting the rotation period
  - Extensive margin: adjusting the tree species
- Our adaptive economic model solves a complex problem by breaking (simplifying) it down into simple steps
- Every year, the forester has 3 choices
  1. Cut the current stand and replant the same species
  2. Cut the current stand and replant with a different species
  3. Let the current stand grow another year

Solving the economic model

- Another way to say this is:
  1. Price*Volume-Cost + Discounted value of a new tree of the same species
  2. Price*Volume-Cost + Discounted value of a new tree of a different species
  3. Discounted value of the current tree if it grows another year
- This is a recursive problem and we use dynamic programming to solve it
- Every year, the forester's decision is the max of the 3 choices and that value is the land value that year
- To get the percentage change, we compare the land values in the starting year with and without climate change

Value of adaptation

- 3 management scenarios:
  1. Naïve: no adjustments
  2. Rotation: adjust only rotation interval
  3. Optimal: adjust both rotation interval and species
- By comparing land values given different management scenarios, we can exactly calculate the value of adaptation

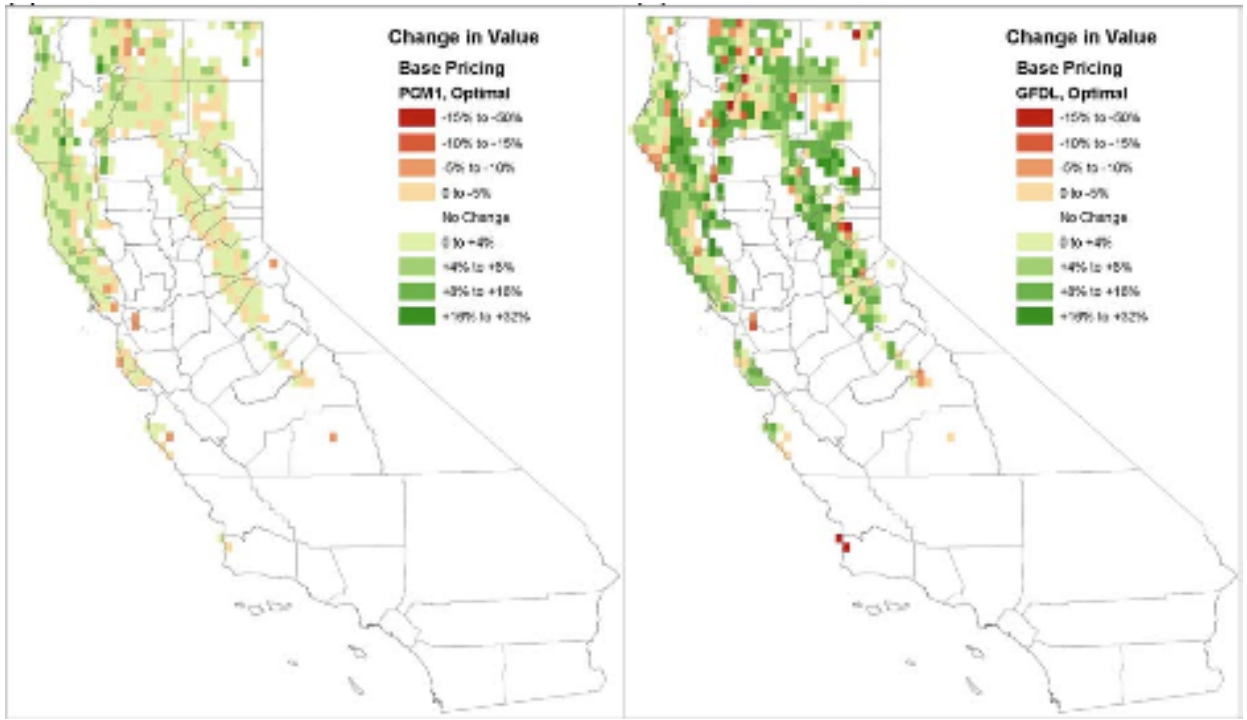
Results

- Our analysis projects a loss of 4.4%-8.5% in total state timber value out to year 2080 under PCM1 and GFDL climate scenarios
- High spatial variability is much stronger than variability between climate scenarios or between management scenarios
- 3 factors drive the spatial variability in the value of timber:
  1. Local tree productivity changes
  2. Species range shifts
  3. Global timber prices

Climate Scenario	Management Scenario		
	Naive	Rotation	Optimal
PCM1	-8.5%	-8.1%	-8.1%
GFDL	-4.7%	-4.4%	-4.9%

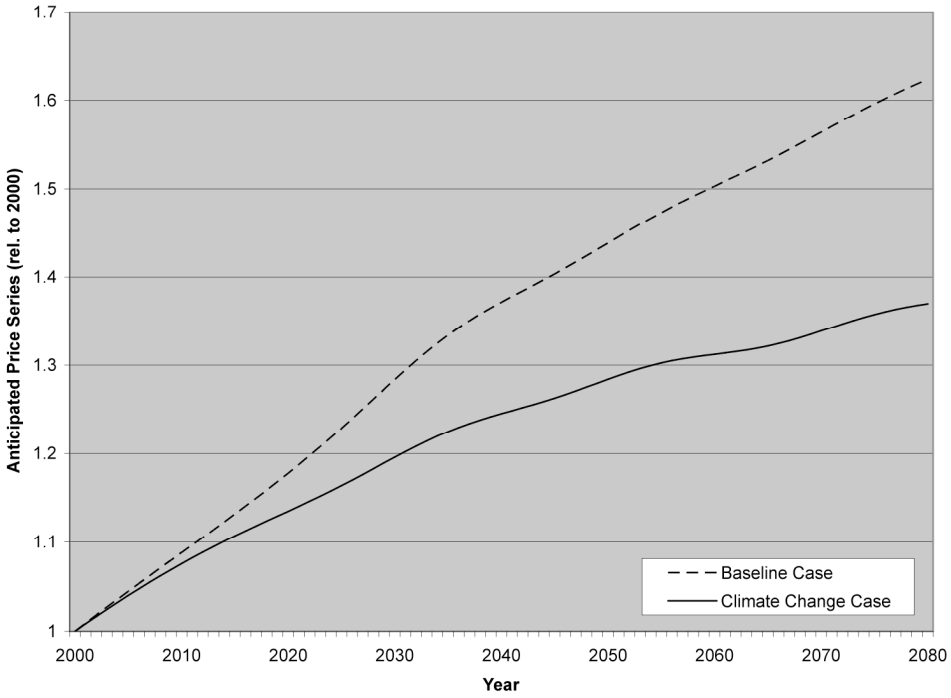
Productivity and range effects

- Productivity: value increase due to warming temperatures leading to more rapid tree growth
- Range: high commercial value species expand their ranges at the expense of low value species
  - Ex: Pine species expands, drives value changes in the Northern Sierra and eastern Amador County



Global timber price effect

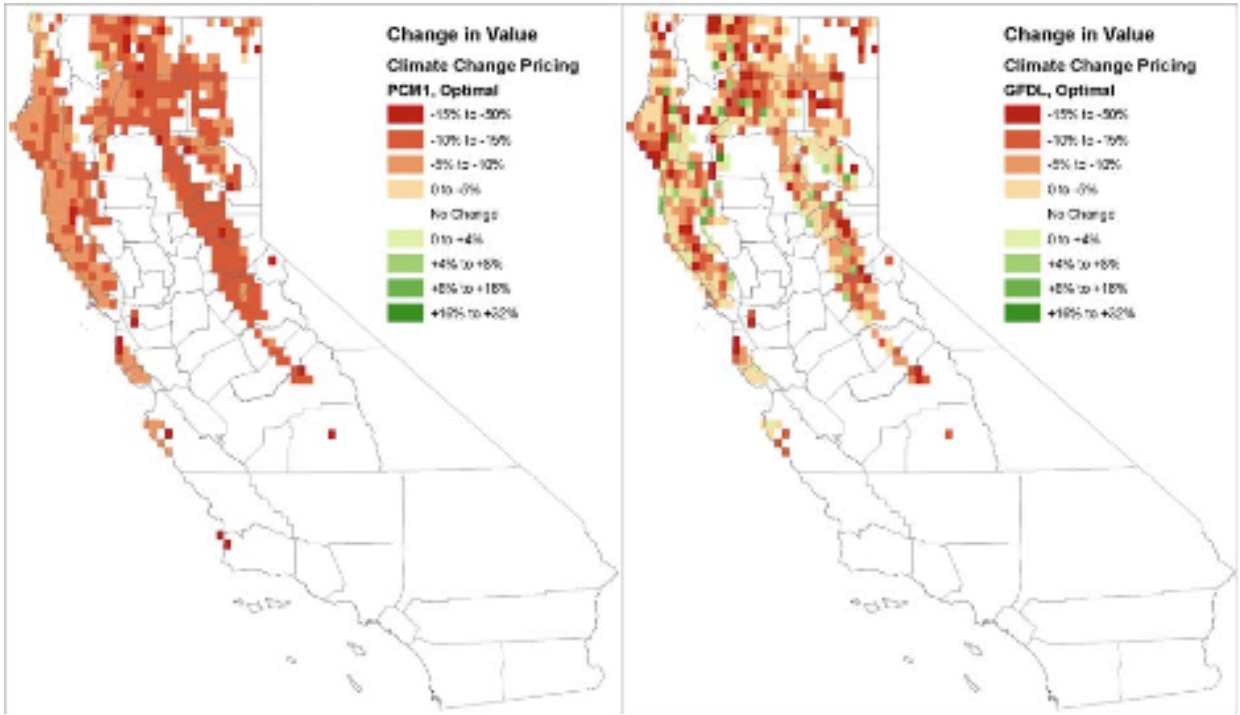
- In general, demand for timber will continue to increase, so prices increase
- However climate change will increase timber supply, leading to price depression
- Decrease in value due to relatively lower prices from climate change



Source: global timber price projections from Sohngen et al. 2001

Including global timber prices…

- Declines dominate: 10%-15% mostly, 15%-50% not uncommon in certain locations
- Areas of strong decline: just inland along Mendocino coast, Santa Cruz mountains, parts of the Sierra, extreme north of the state



Implications for land use and policy

- Climate change in CA can influence land use trends
- When we overlap changes in timber value with projected development maps, we see decreasing timber value can predispose lands to conversion to higher value uses
- Areas north of San Francisco and bordering the Central Valley see substantial declines in the GFDL scenario and they coincide strongly with residential development corridors
- Market dynamics also favor non-forest land uses in Sonoma-Mendocino wine country and in Sierra foothills
- Loss of timberland may be associated with a loss of values not well-represented in markets:
  1. Recreation value
  2. Climate change reduction
  3. Watershed protection
- Policy intervention to preserve these contributions may be a consideration